

UC San Diego

UC San Diego Previously Published Works

Title

Writing in your own voice: An intervention that reduces plagiarism and common writing problems in students' scientific writing.

Permalink

<https://escholarship.org/uc/item/6q46p8kt>

Journal

Biochemistry and molecular biology education : a bimonthly publication of the International Union of Biochemistry and Molecular Biology, 47(5)

ISSN

1470-8175

Authors

Yang, Anqi
Stockwell, Sarah
McDonnell, Lisa

Publication Date

2019-09-01

DOI

10.1002/bmb.21282

Peer reviewed

Writing in Your Own Voice: An Intervention that Reduces Plagiarism and Common Writing Problems in Students' Scientific Writing^[S]

Anqi Yang
Sarah Stockwell
Lisa McDonnell 

From the Division of Biological Sciences, University of California San Diego, La Jolla, California, 92093

Abstract

In many of our courses, particularly laboratory courses, students are expected to engage in scientific writing. Despite various efforts by other courses and library resources, as instructors we are often faced with the frustration of student plagiarism and related writing problems. Here, we describe a simple Writing in Your Own Voice intervention designed to help students become more aware of different types of plagiarism and writing problems, avoid those problems, and practice writing in their own voice. In this article, we will introduce the types of plagiarism and writing problems commonly encountered in our molecular biology laboratory course, the intervention, and

the results of our study. From the evaluation of 365 student reports, we found the intervention resulted in nearly 50% fewer instances of plagiarism and common writing problems. We also observed significantly fewer instances of severe plagiarism (e.g. several sentences copied from an external source). In addition, we find that the effects last for several weeks after the students complete the intervention assignment. This assignment is particularly easy to implement and can be a very useful tool for teaching students how to write in their own voices. © 2019 International Union of Biochemistry and Molecular Biology, 00 (00):1–10, 2019.

Keywords: Plagiarism; writing problems; student scientific writing; laboratory course; lab report

Introduction


Student plagiarism is a topic which raises concern across various academic disciplines, and dealing with this problem has always been an unpleasant and tiresome challenge. Many studies have been devoted to systematic investigations of the types, frequencies, and causes of plagiarism [1]. Based on these inquiries, instructors have developed various teaching strategies and pragmatic interventions aimed to better educate students on this topic. Despite these efforts, plagiarism is still prevalent in student academic discourse. In a study conducted by Bennett [2], 46% of the undergraduate participants self-reported to have at least

once copied an entire paragraph into their work without acknowledgment of the source, while 23% reported to have copied more than once. Another study echoed these issues, whereby 53% of surveyed students reported copying without references, and 57% paraphrased without references [3]. Davis and Ludvigson [4] reported that 76% of their student participants have cheated during either high school or college, among which 80% copied from papers. It is clear that we need to find ways to address this problem.

One complication is that some student plagiarism is unintentional. In our experience, conversations with students reveal that plagiarism is often the result of students' misunderstanding of the rules for using and citing sources, rather than deliberate theft of others' ideas and writing. In this article, we use "plagiarism" to refer to writing in which the student inappropriately uses language from other sources or does not properly give credit to external sources, whether the misuse was intentional or not. Student confusion on this topic is common. For example, although students have strong views on plagiarism behaviors, their definition of plagiarism was still unclear and was not in consensus with that from instructors or institutions [5]. They were also confused about what practices would be categorized as plagiarism

Volume 00, Number 00, Month 2019, Pages 1–10

*To whom correspondence should be addressed. Tel.: (858) 246-0890; Fax: 858-534-0053. E-mail: lmcdonnell@ucsd.edu.

 Additional Supporting Information may be found in the online version of this article.

Received 20 November 2018; Revised 17 April 2019; Accepted 5 June 2019

DOI 10.1002/bmb.21282

Published online 00 Month 2018 in Wiley Online Library (wileyonlinelibrary.com)



and were not equipped with sufficient knowledge to avoid them in their own writing [5]. Similarly, Froese *et al.* [6] found that only 48% of their students had learned proper citation techniques. These findings suggest that students may be receiving inadequate or inconsistent training regarding writing and plagiarism.

Although many institutions offer writing courses, there may be a gap between writing methods in writing courses and those expected in lab courses. Students in large undergraduate institutions often lack opportunities to systematically learn about differences between scientific discourse and writing in other disciplines. As a result, a lab course is often the first time students are asked to produce substantial, systematic scientific writing [7]. As novices, students may rely strongly on experts' writing styles in unfamiliar fields, and such imitation may easily extend to plagiarism. Finally, the lack of a sense of authorship in students could also contribute to writing problems. The sense of author identity is crucial for writers to produce original content representing their own contribution to the academic discipline. In most cases, however, students tend to treat scientific reports as assignments to fulfill rather than serious communications of novel ideas [8].

Plagiarism in student scientific writing may take different forms and vary widely in severity. The two most commonly described plagiarism types are *Copying* and *Patchwriting*, which are our focus in this study. Copying is when the writer uses a sequence of exact words, phrases, or whole sentences from a source. We separate Copying into two categories: copying text using quotation marks and/or references (less problematic) versus copying without quotation marks or references. Copying with references and quotation marks gives credit to the source, making it more of a style problem, rather than plagiarism *per se*, and is thus viewed as less severe compared to copying without a reference and/or quotation marks. In the humanities courses where students often learn plagiarism rules, quoting text with references is an acceptable writing practice. However, in scientific discourse, writers almost always paraphrase sources rather than quoting, and students are sometimes unaware of this style difference.

Patchwriting refers to sentences reproduced from original sources in which the reproduction shows minimal attempt at rephrasing into one's own words or understanding. This often results in phrases that have a few deleted or added words and little grammar restructuring compared to the original source [9]. Many students incorrectly believe that Patchwriting is an acceptable way to paraphrase, so this is an area where education is likely to be particularly helpful.

In addition to Copying and Patchwriting, a Patchwriting-related problem called *Technical Parroting* has been defined by Bertram Gallant *et al.* [7]. Technical Parroting is common in student laboratory reports, and refers to copied content from a lab manual or lecture slides that is often rich with technical details, such as concentrations, volumes, reagents, temperatures, and is often found in the "Methods" section of a lab report. Technical Parroting may go unnoticed by instructors

because lab procedures are often fixed and because there are sometimes a limited number of ways to describe particular procedures. However, identifying the frequency of this kind of writing problem may be informative for instructors who want to help students develop stronger skills at summarizing research methods using their own understanding and written voice.

Many institutional efforts have already been made to prevent plagiarism. Explicit pre-class instructions, information provided in course syllabi, in-class announcements on academic misconduct, and descriptions of how plagiarism violates integrity values and the institution's-related policies have been recommended [10–12]. Similarity-detection software, such as Turnitin®, is also used for systematic detection of academic integrity violations, although such approaches can have limitations. Students sometimes simply copy or patchwrite from primary sources, even when they are required to submit written assignments to detection software [13]. Bertram Gallant *et al.* [7] reported that most of the content matches detected by Turnitin® were not severe enough to warrant reporting an academic integrity violation. However, consistent Copying, Patchwriting, and Technical Parroting remain a problem in many laboratory courses. Thus, to deter plagiarism effectively, and to increase student awareness of how to write in their own voice, it is not enough to give students information and use similarity-detection software; we must also develop students' academic writing skills and have them construct their own awareness of plagiarism [14].

There have been several successful interventions specially designed to improve students' paraphrasing and citation skills. For instance, students were able to obtain a more holistic understanding of plagiarism after practicing paraphrasing techniques [15]. Similarly, Landau *et al.* [16] have found that students given a paraphrasing exercise showed better plagiarism identification abilities. Another approach was to focus on improving students' authorial identity, which helped them develop awareness of authorship, build confidence in writing, and acquire knowledge of how to avoid plagiarism [14]. Nevertheless, few interventions described give both an opportunity to become aware of both different types of plagiarism and provide follow-up exercises to prevent each of them, nor do they measure if the intervention decreased levels of plagiarism in student writing.

In this article, we present a three-step "Writing in Your Own Voice" intervention aimed at raising students' awareness of plagiarism and writing problems by providing step-by-step guidance in identifying and avoiding different types of plagiarism. Importantly, the intervention also includes writing exercises for each plagiarism type, in which students are asked to create their own plagiarized version of sources, correct them, and align the plagiarism errors with our academic integrity values, thus demonstrating their ability to identify plagiarism and also write in their own voice. The intervention was implemented in the form of an out-of-class writing assignment. Our current focus is on upper division biology laboratory

courses, though we have successfully used similar versions of this intervention in lecture classes, lower division biology lab courses, and seminars. We demonstrate that the intervention successfully reduced the frequency and severity of plagiarism and provide suggestions for adapting this intervention for other courses.

Methods

Writing in Your Own Voice Intervention

The Writing in Your Own Voice intervention was a plagiarism awareness writing assignment, which consisted of three main parts (see Supporting Information S1—Writing In Your Own Voice). Part I introduced primary literature, which focused on the purpose of citations and author information. Part II required students to review common writing and plagiarism problems by providing examples, along with corrected versions and explanations for each example. Part III asked students themselves to summarize some information from a primary literature source in three ways: students had to write (i) a summary using Copying plagiarism, (ii) a summary using Patchwriting, and (iii) a summary in their own voice without plagiarism, using proper citation methods. The assignment also asked students to articulate how their deliberately plagiarized examples violate our institution's academic integrity values (we provided a description of those values and examples of how students and instructors can uphold them in the class syllabus). Students submitted their completed assignments to Turnitin® so they could assess the uniqueness of their own writing. The assignment represented 4% of their final course grade.

Data Collection

Data analyzed in this study were collected from an upper division biology laboratory course at a large, public R1 university, and was approved by our human research protections program (Project number 17193XX). The course focuses on theory and practice of recombinant DNA and molecular biology techniques, including creating recombinant plasmids, DNA sequencing, PCR and its applications, bioinformatics, and RNA analysis. Students write multiple short (1–3 pages) scientific reports throughout the course. These reports have the basic components of a scientific paper, including an introduction, a brief overview of the methods, results, and discussion. Students submit their reports to Turnitin® to generate similarity reports which can be viewed by both students and instructors. All of the reports are graded and feedback on their writing is provided. The instructor is responsible for checking the Turnitin® similarity reports to detect any problems that warrant discussion with the student or reporting to the Academic Integrity Office.

To analyze student writing, we collected reports from 185 students in four different lab sections, all taught by the same instructor during four consecutive quarters: Winter 2016, Spring 2016, Fall 2016, and Spring 2017. Two of the four

sections were considered treatment groups (Fall 2016 and Spring 2017) because they completed the “Writing In Your Own Voice” assignment (94 students), and two of the four sections (Winter and Spring 2016) were considered control groups because they did not receive the assignment (91 students). All other parts of the course were consistent between the four sections used in this study (lecture materials, quizzes, final exam). The course syllabus for all groups included information about academic integrity values. Students in the treatment groups completed the assignment by week two of a 10-week quarter. Two lab reports assigned at different times within the quarter were selected for analysis. The first was due between weeks four and five (Report 1), and the second was due at week nine (Report 2). The report guidelines provided to all four sections were the same, except that one lab section eliminated the Methods section from Report 1. This difference was accounted for in data analysis (see below). A total number of 371 reports were collected for data coding, consisting of 187 reports in the Treatment group and 184 reports in the Control group. The mean Grade Point Average (GPA) of each student group used in this study were very similar (Table I), and there were no significant differences in GPA between the any of the control and treatment groups (ANOVA $p > 0.05$). Almost all students in the course were biology majors (Control 92%, Treatment 95%). Also, a nearly identical final exam was used for all four sections included in this study, and there were no significant differences in final exam score distributions between the sections (ANOVA $p > 0.05$). Combined, these comparisons suggest that although the sampling of students for control and treatment was not random, the students in the treatment and control are similar to one another in terms of academic standing, major, and performance, providing greater confidence that differences in levels of plagiarism are not likely the result of non-random control and treatment groups.

TABLE I

Mean GPA of students included in the study, and performance on the final exam (finals are nearly identical from year to year)

<i>Student group</i>	<i>Mean GPA (standard deviation)</i>	<i>Mean percent score on final exam (standard deviation)</i>
Winter 2016— Control	3.27 (0.66)	73.1 (12.4)
Spring 2016— Control	3.17 (0.80)	70.2 (11.1)
Fall 2016— Treatment	3.43 (0.50)	75.7 (10.8)
Spring 2017— Treatment	3.38 (0.56)	75.3 (13.5)

There were no significant differences between any of the groups (ANOVA, $p > 0.05$).



Data Coding

Each student lab report produced a “similarity report” generated by Turnitin®. The lab manual [17] had been previously uploaded so that it would be available for Turnitin® to compare against student writing. In brief, Turnitin® similarity reports highlight any matching phrases to those available online (such as websites and journal articles) or those that have been previously uploaded (such as other student reports). The Turnitin® reports also contain the percentage of the total words in the student report which match each source, an overall matching index (total percentage of the report that matches other sources) and an identification of the matching source(s).

Using an iterative approach, two of the authors (A.Y. and L.M.) designed a rubric to categorize the type, severity, and location of plagiarism in students’ lab reports based on the Turnitin® similarity reports (final rubric is in Table II). First, a random set of 10 lab reports were analyzed independently by A.Y. and L.M. using a coding scheme previously developed by Bertram Gallant *et al.* [7], with additional categories to distinguish between mild to severe instances of plagiarism. Both coders agreed that the rubric was appropriate, and so a second set of five reports were randomly chosen and examined independently by A.Y. and L.M. The coders then met and added clarifying definitions to the rubric to improve consensus. A.Y. and L.M. then examined a third set of six randomly selected reports to ensure coding results were consistent and replicable. Prior to discussion, the two coders achieved 85 and 92% similarity in coding on plagiarism type and severity, respectively. With discussion a 100% consensus was reached, and A.Y. coded the remaining reports. Examples of each type of plagiarism can be found as a Supporting Information S2.

Analysis

Both the control and treatment groups contained a few reports that had large chunks of copied text that made up nearly an entire section or sections of the report. In addition, there were two reports in the control group with very high similarity to one another in both content and syntax. We did not observe this high level of severe plagiarism in any other reports collected and we considered it to be likely caused by individual factors that differed from the majority of student reports. These reports were excluded as outliers from analysis. Three hundred and sixty-five reports were used for the final data analysis. The two treatment groups were grouped together to form a pool of 185 reports (94 of Report 1 and 91 of Report 2), and likewise the two control groups were grouped together to form a pool of 180 reports (89 of Report 1 and 91 of Report 2).

We recorded the counts of each type of plagiarism for each report and ranked the severity of each instance of plagiarism (rubric in Table II) as well as the section of the report where each instance occurred (e.g. Methods, Discussion). Plagiarism counts were normalized by the number of reports in each corresponding group (normalized frequency). Poisson rate tests were performed to measure the difference in normalized

frequency of plagiarism of each type and severity level between treatment and control groups. Chi-squared tests of independence were used to determine whether the distribution of plagiarism type or severity level depended on the Writing in Your Own Voice assignment.

Technical Parroting was not coded for in Report 1 because Report 1 from the Winter 2016 group did not include a Methods section. Thus, some of the Technical Parroting analysis was done only on Report 2.

Results

Effect of Writing in Your Own Voice Intervention on Plagiarism Frequency

A total number of 365 reports were included in our final data analysis (185 reports from 94 students in the treatment group and 180 reports from 91 students in the control group). There were significantly more instances of plagiarism in the control group than in the treatment group (Poisson rate test, $p < 0.01$), with 48% of all of the reports from the treatment group and 79% of the reports from the control group containing at least one problem. Excluding Technical Parroting (because it was only coded in Report 2), the total number of incidences of plagiarism documented was 124 in the treatment and 235 in the control. There were significant decreases in the number of plagiarism instances in both Report 1 and Report 2; when the reports were combined, there were an average of 0.67 instances of plagiarism per report in the treatment group, compared to 1.31 instances per report in the control group (Fig. 1A).

All four types of plagiarism decreased significantly among reports from the treatment group compared to the control group (Fig. 1B): Combining Reports 1 and 2, there were 48% fewer instances of Copying, 60% less Copying with References, and 36% less Patchwriting (Poisson rate test, $p < 0.05$). Looking at Report 2 only, there were 66% fewer instances of Technical Parroting in the reports of the treatment group compared to the control group (Poisson rate test, $p < 0.01$).

Although the *frequency* of each type of plagiarism decreased in the treatment group, there was no significant difference in the *proportions* of each type (Fig. 2, Chi-square test, $p > 0.2$). When Technical Parroting was excluded, Copying-related types of plagiarism made up the majority of problems in both the treatment and control group (68–75%; Fig. 2A). When included in the analysis of Report 2 only, Technical Parroting accounted for roughly 30% of plagiarism instances in both the control and treatment group (Fig. 2B).

Plagiarism problems occurred throughout the reports in both the control and treatment groups, with the exception of the Results section, in which we detected very few problems (Table III). The majority of the problems were detected in the introduction (approximately 40%), followed by methods (approximately 30%) and discussion (approximately 23%). There was no significant difference in the distribution of

TABLE II*Rubric used to identify types and severity level of plagiarism and writing problems in student reports*

Type of plagiarism	Severity levels				Explanation of severity criteria
	Definition	Not considered a problem (0)	Mild (1)	Severe (2)	
Copying	Exact words or sentences (at least 7 words in a row) taken from a source without proper citation/reference to source.	<2% of words in the section	2–10% of word in a section or definitions	>10% of words in a section, or <10% but copied text includes important information such as the purpose or conclusions	A lack of effort or ability to summarize information from another source, or put understanding in one's own words is considered a serious writing problem, so even a small portion of a section that is copied is considered a problem. Statements including the experimental purpose, explaining results, or providing an overall conclusion are considered to be unique to each author and thus copying of those statements is considered severe.
Copying with references	Exact words or sentences (at least 7 words in a row) taken from a source but a citation/reference to the source is provided*.				
Patchwriting	Sentences that are largely reproduced from another source, often containing large sequences of ideas and minimal structural changes that are reproduced with or without proper citations/references.	<5% of words in a section	5–15% of words in a section; definitions, hypotheses.	>15% of words in a section, or <15% but the copied text includes important information such as purpose, explanations, or conclusions.	Compared to Copying, Patchwriting involves some incorporation of one's own writing with that of another source, hence the percentage of words to be considered severe is higher than that of copying.

(Continues)

(Continued)

TABLE II

Type of plagiarism	Severity levels			Explanation of severity criteria
	Not considered a problem (0)	Mild (1)	Severe (2)	
Technical parroting	Copied material from the lab manual or lecture slides Descriptions of experimental conditions that are set in the lab manual (e.g. restriction enzyme conditions or how to measure fluorescence).	<20% of section	>20% of section	There is often a lack of different ways to describe technical protocols or experimental steps, hence the percentage of words that match another source is much higher to be considered severe Technical Parroting compared to Copying.

Technical Parroting was only measured in the Methods section of reports. All other types of plagiarism were coded for in all sections of the report.

* This category also included instances of copied text in quotation marks, which occurred very rarely (<5 instances in the entire data set).

instances among report sections when comparing the treatment and control groups (Table III, Chi-square test, $p > 0.2$).

Effect of the Writing in Your Own Voice Intervention on Plagiarism Severity

In addition to measuring the frequency of plagiarism instances, we also tested whether the Writing in Your Own Voice intervention decreased the severity of plagiarism when it did occur. Instances of plagiarism at all severity levels (see Rubric Table II) decreased significantly in the treatment group compared to the control group (Table IV Normalized levels, Poisson rate test, $p < 0.01$). There was an approximately 50% reduction in instances of plagiarism that were considered not severe or mildly severe, and nearly a 40% decrease in severe instances of plagiarism. The proportion of instances at each severity level was similar between the control and treatment groups (Table IV Percentage of total instances, Chi-square test, $p > 0.2$), and overall about 30% of the instances of plagiarism were coded as severe for each group. The majority of instances labeled as severe were Copying and Patchwriting (Fig. 3A). Nearly 60% of the severe instances of plagiarism were found in the introduction section of the reports in both the control and treatment groups (Fig. 3B). The most significant difference between control and treatment groups regarding severe plagiarism was the near-elimination of severe instances of Technical Parroting in the treatment group (Fig. 3A), resulting in significantly fewer severe instances of plagiarism in the methods section of the treatment group reports (Fig. 3B, Chi-square $p < 0.01$).

Discussion

Analysis of 365 lab reports has shown that our Writing in Your Own Voice assignment significantly decreased all types of common plagiarism and writing problems in student reports, and that this reduction remained 5 weeks after the assignment was completed. These results indicate that the intervention successfully raised student awareness of how to write in their own voice and changed student writing practices.

In addition to traditional explicit pre-class instructions, such as the course syllabus and class announcements that have been already recommended [10–12], our Writing in Your Own Voice assignment goes beyond a general reminder. It gives students an in-depth understanding of different plagiarism types, why they are a problem, and—most importantly—how to correct or avoid them. Exposure to sample plagiarism texts likely enhanced the connection between plagiarism issues and students' real-life experience [16]. One of the likely reasons the intervention was successful was that it provided students with the opportunity to first create a plagiarism problem in their writing and articulate why it is a violation of our institution's academic integrity values, and then follow this with writing their own corrections of their "mistakes." An advantage to engaging in writing is the benefit of developing a deeper understanding of the material [18, 19]. In this case,

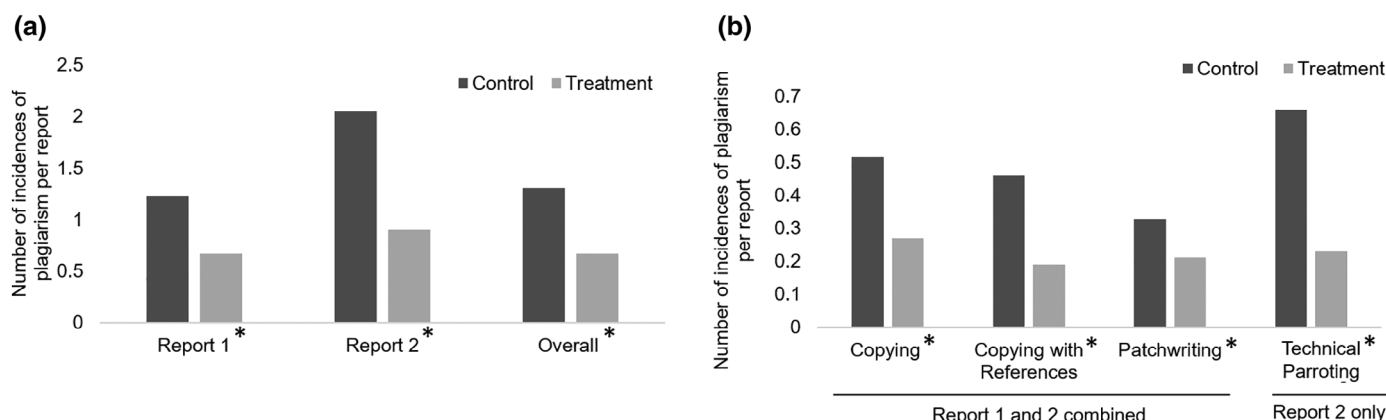


FIG 1

The Writing in Your Own Voice intervention reduced plagiarism instances across all categories. (A) Normalized frequency in Report 1, Report 2, and overall (two reports combined). Report 1 was completed by students 2 weeks after the plagiarism awareness intervention, and Report 2 was completed 9 weeks after the intervention. (B) Normalized frequencies of each type of plagiarism. Report 1 n = 89 control, 94 treatment; Report 2 n = 91 control, 91 treatment. *Comparisons of rates between treatment and control were significantly different (Poisson rate test, $p < 0.05$).

their knowledge of plagiarism was no longer limited to a superficial reading experience, but involved practical experience with correcting “mistakes” and making improvements, skills that can be applied to future writing. The assignment also articulates the purpose of citations and puts a positive light on the academic integrity values we aim to pursue, as opposed to listing detailed penalties upon violation. With the positive tone of our assignment, students are encouraged to become responsible researchers and writers [14]. The assignment is a fairly

simple reading and writing exercise that we estimate takes students approximately 1 hr to complete. The assignment being worth course points likely enhanced student motivation to complete the assignment materials more carefully, which may have contributed to students’ applying the lessons learned from this assignment to later writing in the course.

The Writing in Your Own Voice assignment also provided a great deal of information about the types of plagiarism and writing problems that are common in student scientific

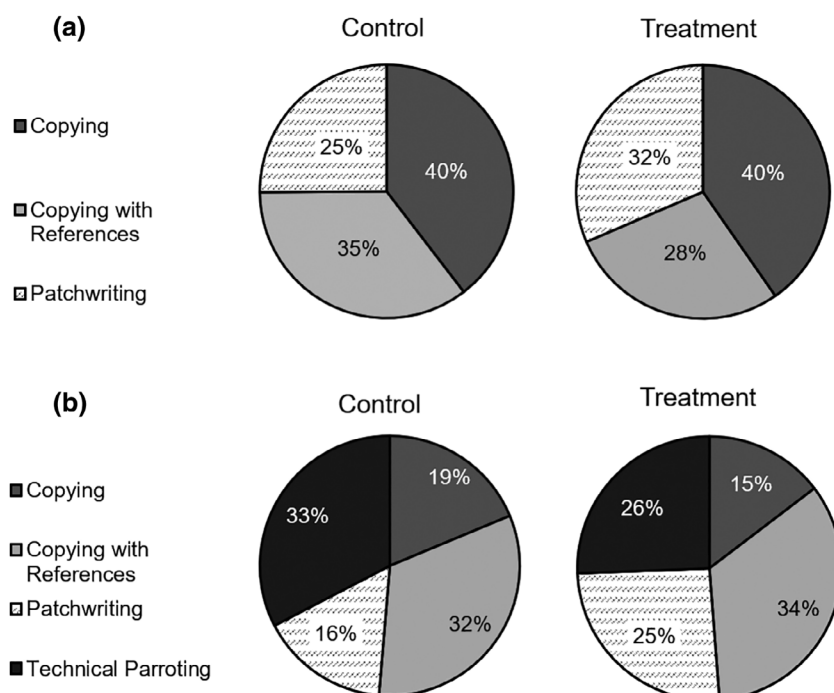


FIG 2

The Writing in Your Own Voice intervention does not affect proportions of plagiarism types. (A) Proportion of plagiarism types, Reports 1 and 2 combined, but Technical Parroting was excluded. Control n = 180 reports, treatment n = 185 reports. (B) Proportion of plagiarism types from Report 2 only. Control n = 91 reports, treatment n = 91 reports.

TABLE III

Proportion of instances of plagiarism among report sections did not change after the Writing in Your Own Voice assignment

Report section	Proportion of instances	
	Control (n = 326 instances)	Treatment (n = 176 instances)
Introduction	44%	36%
Methods	29%	35%
Results	4%	5%
Discussion	23%	24%

Control n = 180 reports, treatment n = 185 reports. All four types of plagiarism were considered, and Reports 1 and 2 were combined. There is no significant difference between control and treatment proportions (Chi-square test, $p > 0.05$).

writing. Copying was the most common type of plagiarism (approximately 40% of instances), followed by Patchwriting (31%). In our coding rubric, we considered the use of seven or more words in a row from an external source as Copying. Many of the Copying instances were labeled as “mild” or “not considered a problem” because of the type of information they contained, or because they constituted such a small fraction of a section of the report, suggesting that the student largely put effort into writing in their own voice. However, nearly 50% of the severe instances of plagiarism were classified as Copying, which suggests that although students’ ability to write in their own voice improved, there are still problems around how and when to use their own wording and phrasing. Many of the Copying instances were phrases from an external source such as a journal article or the lab manual. This highlights the need to provide students with more practice and feedback on how to incorporate what they learn from other sources into their thinking, and then into their own words.

TABLE IV

The intervention reduced the frequency of plagiarism at each severity level but did not substantially affect how plagiarism instances were distributed across severity levels

Severity level	Normalized: total instances/number of reports		Percentage of total plagiarism instances	
	Control	Treatment	Control (%)	Treatment (%)
0: Not considered a problem	0.31	0.15	28	27
1: Mild	0.54	0.25	40	39
2: Severe	0.46	0.28	32	34

Normalized frequency per report and percentage of total instances that fall into each severity category are presented. Plagiarism instances are from Reports 1 and 2, and include all types of plagiarism. Control n = 180 reports, treatment n = 185 reports. Normalized frequencies are significantly different (Poisson rate test, $p < 0.01$).

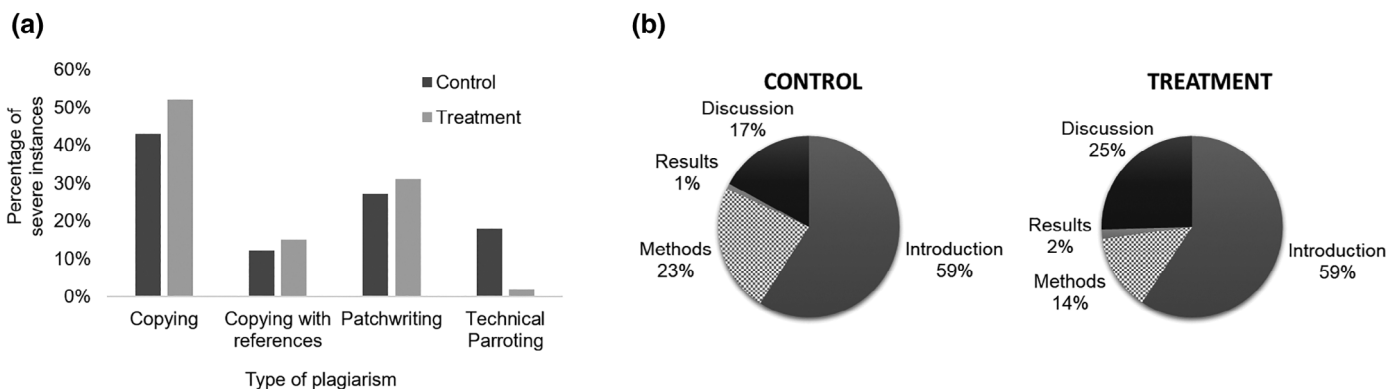


FIG 3

Most severe instances of plagiarism are Copying and occur in the Introduction section of reports. (A) Percentage of severe instances that were Copying, Copying with References, Patchwriting, or Technical Parroting. Reports 1 and 2 combined, control n = 180 reports, treatment n = 185 reports. (B) Percentage of severe instances that were found in each section. Reports 1 and 2 combined, control n = 180 reports, treatment n = 185 reports. Distribution of severe instances is significantly different between treatment and control (both A and B, Chi-square $p < 0.01$).

Patchwriting remained a significant problem for students even after the Writing in Your Own Voice intervention. Although we found a decrease in all types of plagiarism in the treatment group, the smallest decrease was in the instances of Patchwriting (36% decrease compared to a 59% decrease in Copying and a 48% decrease in Copying with References, Fig. 1B). When examining most of the Patchwriting cases, we could see students' attempts to paraphrase materials from external sources, but they often failed to correctly credit the external source. It was also very common for Patchwriting instances to include language from the course Laboratory Manual. It may be possible that students view ideas and information gained from the manual or lectures as common knowledge in scientific fields, which do not require citations. Another possibility is that students may not have sufficient experience engaging with published scientific sources and using them in their own writing during undergraduate classes [9, 20, 21], since their readings are often limited to lecture slides and lab manuals. A lack of exposure to common writing practices in scientific literature may contribute to their limited awareness of when and how to use and cite certain sources. In a small number of cases, though, students simply restructured sentences and substituted words and phrases with synonyms. Sometimes their modification was so minimal that the matching content, although correctly cited, warranted reporting as a violation of academic integrity policies. A previous study on student knowledge of proper text paraphrasing revealed that students tend to have difficulty in distinguishing plagiarism from paraphrasing [22], which could lead students to insufficiently modify the original content. Some students may also incorrectly believe that as long as the author is credited, copying with minor modifications is not considered plagiarism [22]. The frequency of Patchwriting in the treatment group from our study indicates that many students still lack ability to paraphrase from complex, unfamiliar texts, which other researchers have observed [23]. We suggest that such Patchwriting problems mainly result from insufficient practice at synthesizing new information and using it in writing, as well as a lack of targeted feedback on paraphrasing and writing approaches, rather than deliberate academic integrity violations. One way to address this issue will be to include more opportunities for students to practice appropriate paraphrasing and citing behaviors, either in our current intervention or in the form of a separate pre-class assignment [15, 16, 24].

Although there was a decrease in the frequency of plagiarism and writing problems, our Writing in Your Own Voice intervention did not change the location within the reports where the majority of writing problems occurred. Problems were primarily observed in the Introduction section (about 40%), followed by Methods (about 30%) and Discussion (about 25%), in both the treatment and control groups (Fig. 2). Our data is consistent with a previous study [7] in which lab reports requiring either background information or a detailed experimental design and techniques section were found to have the greatest number of problems in these sections. Meanwhile, the

Results section, where students had to describe original data, contained the fewest number of problems. This suggests that students are capable of writing in their own voice to present data. However, describing results may also be an easier writing task compared to writing about biological background (Introduction) or explanations (Discussion), and thus the simplicity of the writing may be another reason that we rarely see problems in the Results section. The persistence of problems in the Introduction could be an indication that many students put relatively little effort into presenting lab manual-sourced content into their own words [7], or that they may not fully understand the information in these sections well enough to summarize it in their own words. The distribution of severe instances of plagiarism in the Introduction and Discussion sections of the reports was similar for the treatment and control groups, suggesting that the Writing in Your Own Voice intervention may not have changed students' overall approaches to writing these sections of the report. Students may often rely on the lab manual for background information and methods descriptions, leading to the high instances of problems in these sections. Problems in the Discussion sections were often plagiarism of external sources, suggesting that students are trying to find information to support their discussion, but may still lack some of the skills required to synthesize and use this information (see discussion of Patchwriting problems above).

Another reason why students may struggle with writing, or may not alter their approach to writing, could be that they lack authorial identity and the motivation to approach lab reports as a serious scientific writing experience, seeing them only as requirements for course points [25]. If so, students may use different strategies for writing the various sections of the report, applying less effort to sections where information is readily available (such as the lab manual) and more effort to those where it is harder to find information (such as the Results). Abasi *et al.* [8] found that students' authorial identities and experience with scientific writing affected how they viewed the use of external sources in their writing, their approach to using those sources, and their ability to write without plagiarism. Developing an authorial identity such that students view themselves as writers who make a novel contribution to the field affects how they write and use external sources [8]. Part of developing an authorial identity may be influenced by the role they play in the research, the audience for whom they are writing, and how they view themselves in the discipline. Traditionally structured lab exercises, or "cook-book" activities, have been widely recognized as limiting student engagement with the entire research procedure, and affecting writing practices [26]. Lab courses designed to engage students in genuine research, as well as provide opportunities to become more invested in the writing process, may help students approach writing with more personal investment and commitment to writing in their own voices.

Among the four treatment groups in our study, one of the groups (Spring 2017) was given more ownership over the project that was the focus of Report 2. Specifically, these students

were allowed to choose their experimental variable, and were much more heavily involved in designing the experiment. The results were also genuinely novel; neither they nor the instructor knew what they would be in advance. This adjustment was in contrast to the usual lab module where students would be assigned a fixed experimental variable and the results would be predictable. We propose that the changes in Spring 2017 may have provided students with a more authentic research experience. Interestingly, there was a significant decrease in plagiarism and writing problems in Report 2 in this group of students compared to the other treatment group (a significant decrease in plagiarism instances between the control groups and the treatment groups was maintained when the Spring 2017 group was removed from analysis, so although significant, the Spring 2017 was not driving the decrease in the overall treatment group). This unexpected discovery further supports the claim that there is a relationship between authorial identity and plagiarism. A previous study also provides evidence that an intervention inducing student authorial identity construction in academic writing helps increase their knowledge and prevents unintended plagiarism [14]. Further exploration into the strategies students take when approaching writing their lab reports could reveal a clearer answer as to why we see persistent writing problems in certain sections and will help us better understand the role of project ownership and authentic research on student writing in lab courses.

In conclusion, our simple Writing in Your Own Voice intervention to raise plagiarism awareness and give students hands-on experience with different types of plagiarism has had a significant positive impact on student writing, dramatically decreasing the instances of severe plagiarism and common writing problems. Future iterations of the assignment may include more support through practice and feedback to improve students' ability to use primary literature sources and paraphrase appropriately. We welcome inquiries from instructors about adapting this intervention for use in their own courses.

Acknowledgments

The authors thank Dr. Stanley Lo helping refine the Writing in Your Own Voice assignment and Dr. Emily Grossman for testing the assignment in her class. Thank you to Drs. Tricia Bertram Gallant, Madeleine Picciotto, Goran Bozinovic, and Ella Tour for sharing their plagiarism coding rubric.

REFERENCES

- [1] Park, C. (2003) In other (people's) words: Plagiarism by university students—Literature and lessons. *Assess. Eval. High. Edu.* 28(5), 471–488.
- [2] Bennett, R. (2005) Factors associated with student plagiarism in a post-1992 university. *Assess. Eval. High. Edu.* 30, 137–162.
- [3] Franklyn-Stokes, A., Newstead, S. (1995) Undergraduate cheating: Who does what and why? *Stud. High. Educ.* 20(2), 159–172.
- [4] Davis, S. F., Ludvigson, H. W. (1995) Additional data on academic dishonesty and a proposal for remediation. *Teach. Psychol.* 22(2), 119–121.
- [5] Ashworth, P., Bannister, P., Thorne, P., Students on the Qualitative Research Methods Course Unit (1997) Guilty in whose eyes? University students' perceptions of cheating and plagiarism in academic work and assessment. *Stud. High. Educ.* 22(2), 187–203.
- [6] Froese, A. D., Boswell, K. L., Garcia, E. D., Koehn, L. J., Nelson, J. M. (1995) Citing secondary sources: Can we correct what students do not know? *Teach. Psychol.* 22(4), 235–238.
- [7] Gallant, T. B., Picciotto, M., Bozinovic, G., Tour, E. (2019) Plagiarism or not? Investigation of Turnitin®-detected similarity hits in biology lab reports. *Biochem. Mol. Biol. Educ.* <https://doi.org/10.1002/bmb.21236>.
- [8] Abasi, A. R., Akbari, N., Graves, B. (2006) Discourse appropriation, construction of identities, and the complex issue of plagiarism: ESL students writing in graduate school. *J. Second. Lang. Writ.* 15(2), 102–117.
- [9] Howard, R. M., Serviss, T., Rodrigue, T. K. (2010) Writing from sources, writing from sentences. *Writ. Pedagogy.* 177(2), 177–192.
- [10] Carroll, J., Appleton, J. (2001) *Plagiarism: A Good Practice Guide*, Oxford Brookes University, UK: JISC and Oxford.
- [11] Carroll, J. (2002) *A Handbook for Detering Plagiarism in Higher Education*, Oxford. Oxford Brookes University, UK: Oxford Centre for Staff and Learning Development (OCSLD).
- [12] Culwin, F. (2006) An active introduction to academic misconduct and the measured demographics of misconduct. *Assess. Eval. High. Edu.* 31(2), 167–182.
- [13] Warn, J. (2006) Plagiarism software: no magic bullet! *High. Educ. Res. Dev.* 25(2), 195–208.
- [14] Elander, J., Pittam, G., Lusher, J., Fox, P., Payne, N. (2010) Evaluation of an intervention to help students avoid unintentional plagiarism by improving their authorial identity. *Assess. Eval. High. Edu.* 35(2), 157–171.
- [15] Barry, E. S. (2006) Can paraphrasing practice help students define plagiarism? *College Student J.* 40(2), 377–384.
- [16] Landau, J. D., Druen, P. B., Arcuri, J. A. (2002) Methods for helping students avoid plagiarism. *Teach. Psychol.* 29(2), 112–115.
- [17] Butler, M., Mel, S., McDonnell, L. (2016) *BIMM 101 Recombinant DNA Lab Manual*, University of California San Diego, Hayden-McNeil, Plymouth, MI.
- [18] Rivard, L. P. (1994) A review of writing to learn in science: Implications for practice and research. *J. Res. Sci. Teach.* 31(9), 969–983.
- [19] Langer, J. A., Applebee, A. N. (1987) How writing shapes thinking: a study of teaching and learning (NCTE Research Rep. No. 22), National Council of Teachers of English, Urbana, IL.
- [20] Horning, A. S. (2007) Reading across the curriculum as the key to student success. <http://wac.colostate.edu/atd/articles/horning2007.cfm>
- [21] Jamieson, S. (2013) Reading and engaging sources: what students' use of sources reveals about advanced reading skills. <https://wac.colostate.edu/atd/reading/jamieson.cfm20->
- [22] Roig, M. (1997) Can undergraduate students determine whether text has been plagiarized? *Psychol. Rec.* 47(1), 113–122.
- [23] Roig, M. (1999) When college students' attempts at paraphrasing become instances of potential plagiarism. *Psychol. Rep.* 84(3), 973–982.
- [24] Schuetze, P. (2004) Evaluation of a brief homework assignment designed to reduce citation problems. *Teach. Psychol.* 31(4), 257–262.
- [25] Pittam, G., Elander, J., Lusher, J., Fox, P., Payne, N. (2009) Student beliefs and attitudes about authorial identity in academic writing. *Stud. High. Educ.* 34(2), 153–170.
- [26] Moskovitz, C., Kellogg, D. (2011) Inquiry-based writing in the laboratory course. *Science* 332(6032), 919–920.